EXHIBIT 21

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SAMSUNG ELECTRONICS CO., LTD., SAMSUNG ELECTRONICS AMERICA, INC., GOOGLE LLC, and CISCO SYSTEMS, INC.,
Petitioners

v.

XR COMMUNICATIONS, LLC, D/B/A VIVATO TECHNOLOGIES,
Patent Owner

IPR2022-00613
Patent No. 10,594,376 B2

Declaration of Branimir Vojcic, D.Sc.

Table of Contents

Patent Owner's Exhibit List

Exhibit	Description
2001	Joint Claim Construction Statement, *XR Communications v. Samsung*, W.D. Tex. Case No. 21-cv-00626-ADA, Dkt. No. 40 (June 8, 2022) ("JCCC")
2002	U.S. Patent Publication 2004/0014429 ("Guo")
2003	Case Readiness Status Report, *XR Communications v. Samsung*, W.D. Tex. Case No. 21-cv-00626-ADA, Dkt. No. 24 (Dec. 13, 2021)
2004	Order Appointing Technical Advisor, *XR Communications v. Samsung*, W.D. Tex. Case No. 21-cv-00626-ADA, Dkt. No. 34 (Apr. 21, 2022)
2005	Defendants' Preliminary Invalidity Contentions for U.S. Patent No. 10,594,376 in *XR Communications v. Samsung Electronics Co., Ltd. and Samsung Electronics America, Inc.*, W.D. Tex. Case No. 21-CV-00626-ADA, *XR Communications v. Google LLC*, W.D. Tex. Case No. 21-CV-00625-ADA, and *XR Communications v. Cisco Systems, Inc. and Meraki LLC*, W.D. Tex. Case No. 21-CV-00623-ADA
2006	Plaintiff XR Communications, LLC's Preliminary Disclosure Of Asserted Claims and Infringement Contentions cover pleadings in *XR Communications v. Cisco Systems, Inc. and Meraki LLC*, W.D. Tex. Case No. 21-CV-00623-ADA
2007	Plaintiff XR Communications, LLC's Preliminary Disclosure Of Asserted Claims and Infringement Contentions cover pleadings in *XR Communications v. Google LLC*, W.D. Tex. Case No. 21-CV-00625-ADA
2008	Plaintiff XR Communications, LLC's Preliminary Disclosure Of Asserted Claims and Infringement Contentions cover pleadings in *XR Communications v. Samsung Electronics Co., Ltd. and Samsung Electronics America, Inc.*, W.D. Tex. Case No. 21-CV-00626-ADA

Exhibit	Description
2009	July 25, 2022, Order Assigning the Business of the Court as it Relates to Patent Cases (W.D. Tex.)
2010	Court's Preliminary Claim Constructions in *XR Communications v. Samsung Electronics Co., Ltd. and Samsung Electronics America, Inc.*, W.D. Tex. Case No. 21-CV-00626-ADA, *XR Communications v. Google LLC*, W.D. Tex. Case No. 21-CV-00625-ADA, and *XR Communications v. Cisco Systems, Inc. and Meraki LLC*, W.D. Tex. Case No. 21-CV-00623-AD
2011	9/1/22 Markman Hearing Transcript in *XR Communications v. Samsung Electronics Co., Ltd. and Samsung Electronics America, Inc.*, W.D. Tex. Case No. 21-CV-00626-ADA, *XR Communications v. Google LLC*, W.D. Tex. Case No. 21-CV-00625-ADA, and *XR Communications v. Cisco Systems, Inc. and Meraki LLC*, W.D. Tex. Case No. 21-CV-00623-ADA
2012	Special Master Report and Recommendation on Claim Construction, *XR Comm'ns LLC v. D-Link Sys.*, C.D. Cal. Case No. 8:17-cv-569-DOC-JDE, Dkt. No. 280 (Jan. 27, 2022)
2013	Order Adopting Special Master's Report and Recommendations re: Clam Construction, *XR Comm'ns LLC v. D-Link Sys.*, C.D. Cal. Case No. 8:17-cv-569-DOC-JDE, Dkt. No. 312 (Apr. 18, 2022)
2014	Claim Construction Order, *XR Comm'ns LLC v. Cisco Sys.*, W.D. Tex. Case No. 6:21-cv-00623-ADA, Dkt. No. 56 (Sept. 30, 2022)
2015	"Transceiver" in IEEE 100 Authoritative Dictionary of IEEE Standards Terms, 7th Ed. (2000)
2016	"Transceiver" in McGraw-Hill Dictionary of Scientific and Technical Terms, Fourth Edition (1989)

I, Dr. Branimir Vojcic, declare as follows:

1. I have personal knowledge of the facts set forth herein and if called and sworn as a witness I could and would testify competently thereto.

1. EXPERT BACKGROUND AND QUALIFICATIONS

2. Included below is a summary of my educational background, career history, publications, and other relevant qualifications. In addition, I am attaching my Curriculum Vitae, which includes additional information about my qualifications and publications, as Appendix A to this Declaration.

3. I am an expert in wireless technology and other areas of telecommunications, signal processing, and electrical engineering. I am presently a Professor Emeritus of Engineering and Applied Science at The George Washington University. I retired from the university in May 2015, where I was a member of the faculty since September 1, 1991. In addition, I have served as a consultant for a number of companies in the wireless communications industry in various technology areas. I have also served on numerous committees and as a reviewer and editor for several journals, conferences, and organizations.

4. I am presently President of Xplore Wireless, LLC, a small telecommunication consulting company. I was also a co-founder, Director, CEO and CTO of LN2, a startup in the telecommunication space, until 2020.

5. Appendix A is a current copy of my CV. As can be seen in Appendix A, I received my Diploma of Engineering, Master of Science, and Doctor of Science degrees in Electrical Engineering from the University of Belgrade in Yugoslavia in 1981, 1986, and 1989, respectively. The primary focus of my Doctor of Science studies was on Code Division Multiple Access (CDMA) and spread spectrum communications technologies.

6. In 1991, I joined The George Washington University as an Assistant Professor and was promoted to Associate Professor and Professor in 1997 and 2000, respectively. From 2001 to 2004, I served as the Chairman of the Electrical and Computer Engineering Department at The George Washington University. During my tenure at The George Washington University, until May 2015, I taught many different courses on communications theory and networks, wireless communications, CDMA, and I was a course director for a number of courses in communications. I have supervised students mostly in the areas of communications and coding theory, wireless communications/networks, CDMA (including IS-95, CDMA2000, WCDMA/HSDPA/HSUPA) and OFDM/LTE and have been a thesis director for a number of Doctor of Science candidates, who now have successful careers in academia, industry, and government.

7. My research in the areas I just mentioned has been supported by the communications industry and various Government agencies, such as Advanced

Research Project Agency (ARPA), National Science Foundation (NSF), and National Security Agency (NSA). Much of this research concerns communications theory, performance evaluation, modeling wireless networks, multi-user detection, adaptive antenna arrays, and ad-hoc networks.

8. I have authored or co-authored numerous journal and conference papers, contributed to various books, and co-authored a text book on CDMA, entitled "The cdma2000 System for Mobile Communications," Prentice Hall, 2004. I also served as a co-editor of a book on wireless communications, entitled "Multiaccess, Mobility, and Teletraffic in Wireless Communications, Volume III," Kluwer Academic Publishers, Norwell, Massachusetts, 1998. My CV includes a detailed listing of my publications.

9. I have also received awards for my work. In 1995, I received the prestigious National Science Foundation Faculty Early CAREER Development Award. The award is given annually by NSF to a select group of young professors nationwide to promote excellence in teaching and research.

10. I have served as a consultant for numerous companies in the wireless communications industry in technology areas, in the areas of 2G/3G/4G mobile technologies, Wireless LANs, new generation broadcast systems, advanced mobile satellite systems and other aspects of modern communication systems. I have also taught academic courses as well as short courses for the industry and government on

various aspects of communications in the areas of 2G, 2.5G, 3G, and 4G cellular standards, such as CDMA2000 1xRTT, CDMA2000 Evolution Data Optimized (EVDO), Wideband Code Division Multiple Access (WCDMA), and LTE.

11. I am a Senior Member of the IEEE and was an Associate Editor for IEEE Communications Letters and Journal on Communications and Networks. I served as a member of technical program committees, as a session organizer for many technical conferences and workshops, and as a reviewer of technical papers for many journals and conferences.

12. I am a co-inventor of U.S. Patent No. 6,523,147, entitled "Method and Apparatus for Forward Error Correction Coding for an AM In-Band On-Channel Digital Audio Broadcasting System," US Patent No. 8,595,590 B1, entitled "Systems and Methods for Encoding and Decoding Check-Irregular Non-Systematic IRA Codes," and applications, "Joint Source-Channel Decoding with Source Sequence Augmentation", US 20140153654 A1, Jun 5, 2014, "Systems and Methods for Advanced Iterative Decoding and Channel Estimation of Concatenated Coding Systems", US 20140153625 A1, Jun 5, 2014, "Advanced Decoding of High/Medium/Low Density Parity Check Codes", PCT/US13/72883, and International Application Number PCT/CA01/01488, entitled "Multi-User Detector For Direct Sequence - Code Division Multiple Access (DS/CDMA) Channels."

13. Over the last several years I have evaluated many (on the order of hundreds) patents that are essential or potentially essential to wireless standards for various clients. These evaluations typically include, for example, analyzing whether the patent claims read on the relevant standard, considering the importance of the technological inventions claimed, analyzing how such claimed inventions compare to other similar patents in the field, searching for and reviewing potential prior art, reviewing and analyzing the prosecution histories of patents relevant to potential claim construction, infringement, or other issues, reviewing and analyzing the working group documents related to the relevant standard in relation to the claimed invention, and considering whether there are available alternatives to the claimed inventions.

14. I have provided expert reports, expert depositions, and testimony over the past 8 years in numerous cases involving many aspects of wireless communications.

15. In forming my opinion, I have reviewed, considered, and had access to U.S. Patent No. 10,594,376 ("'376 Patent"), including its specifications and claims, as well as its prosecution histories and provisional applications; the Petition in this action; the Institution Decision in this action; Petitioners' exhibits, including without limitation Ex. 1003 (the Ding Declaration), Ex. 1005 (Gerlach), and Ex. 1006 (Barratt); and the exhibits cited in this declaration. I have also relied on my

professional and academic experience in the field of wireless communication. I reserve the right to consider additional documents as I become aware of them and to revise my opinions accordingly.

2. LEVEL OF ORDINARY SKILL IN THE ART

16. I am familiar with the concept of the person of ordinary skill in the art ("POSITA") and have reviewed Dr. Ding's and Petitioner's views on the definition and qualifications of the POSITA for in this IPR proceeding.

17. In my opinion, the person of ordinary skill in the art of the patented technology at the time of the invention of the asserted patents would have a bachelor's degree in electrical engineering or the equivalent and 2–3 years of work experience with digital wireless communication, or the equivalent. In forming my opinions below, I apply this definition. I am at least a POSITA under this definition, and I was so as of November 4, 2002.

18. Dr. Ding's definition of the level of ordinary skill is: "A person having ordinary skill in the art would have had at least a Bachelor's degree in Electrical Engineering or a related field, and three to four years of work experience in wireless communications, or a Master's degree and at least two years of work experience in wireless communications." EX-1003 at 11-12. I am at least a POSITA under this definition, and I was so as of November 4, 2002.

19. Although Dr. Ding's opinion regarding the level of skill in the art is slightly different than mine, none of my opinions would be different under his level of ordinary skill.

3. LEGAL PRINCIPLES

20. I am not an attorney. I offer no opinions on the law. But counsel has informed me of the following legal standards relevant to my analysis here. I have applied these standards in arriving at my conclusions.

3.1. Burden of Proof

21. I understand that in an *inter partes* review the petitioner has the burden of proving a proposition of unpatentability by a preponderance of the evidence.

3.2. Claim Construction

22. I understand that the Board will apply the "plain and ordinary meaning" standard to claim construction in this proceeding. I understand that the plain and ordinary meaning of a claim term is the meaning that the term would have to a person of ordinary skill in the art in question at the time of the invention when read in view of the patent claims and the specification.

23. I understand that the Board does not construe claim terms unnecessary to resolving the controversy.

3.3. Anticipation[1]

24. It is my understanding that invalidation by "anticipation" only exists if a single alleged prior art reference discloses each and every limitation of the claim at issue, either expressly or inherently. In other words, every limitation of the claim must appear in a single prior art reference for the reference to anticipate that claim. I also understand that all limitations of the claim must be disclosed in the reference as they are arranged in the claim. I also understand that anticipation by a preponderance of the evidence requires a showing that a person could make and use the claimed invention by looking at one reference. A requirement of a claim that is missing from a prior art reference may be disclosed inherently if that missing requirement is necessarily present in the prior art. I also understand that to be considered anticipatory, the prior art reference must be enabling and must describe the patentee's claimed invention sufficiently to have placed it in the possession of a person of ordinary skill in the field of invention.

3.4. Obviousness

25. I understand that a claim of a patent may not be novel even though the invention is not identically disclosed or described in the prior art so long as the

[1] I note that anticipation is not at issue in this IPR, but I nonetheless state my legal understanding of anticipation for the sake of completeness.

differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious to a person having ordinary skill in the art in the relevant subject matter at the time the invention was made.

26. I understand that, to demonstrate obviousness, it is not sufficient for a petition to merely show that all of the elements of the claims at issue are found in separate prior art references or even scattered across different embodiments and teachings of a single reference. The petition must thus go further, to explain how a person of ordinary skill would combine specific prior art references or teachings, which combinations of elements in specific references would yield a predictable result, and how any specific combination would operate or read on the claims. Similarly, it is not sufficient to allege that the prior art *could* be combined, but rather, the petition must show *why* and *how* a person of ordinary skill *would* have combined them.

27. I understand that, to demonstrate obviousness, a petition must accurately identify and analyze the differences between the claimed invention and the prior art.

28. I understand that obviousness cannot be shown by conclusory statements, and that the petition must provide articulated reasoning with some rational underpinning to support its conclusion of obviousness.

4. SUMMARY OF '376 PATENT

29. The '376 Patent (Ex. 1001) is entitled "Directed wireless communication" and relates to "a multi-beam directed signal system [that] coordinates directed wireless communication with client devices. A transmit beam-forming network routes data communication transmissions to the client devices via directed communication beams that are emanated from an antenna assembly, and a receive beam-forming network receives data communication receptions from the client devices via the directed communication beams." Ex. 1001 at 2:6-16. The '376 Patent discloses a wireless communications apparatus that comprises an "antenna array 302" with a plurality of "antenna elements" to emanate an array of multiple directed communication beams 214(1), 214(2),…214(N). Ex. 1001, Figs. 2, 3. The '376 Patent teaches that the apparatus receives signal transmissions simultaneously via directed communication beams. Ex. 1001 at 3:38-52 ("An increase in communication range is achieved by beamforming directed communication beams which simultaneously transmit directed signals and receive communication signals from different directions via receive and transmit beam-forming networks.").

30. In one embodiment, "antenna array 302 can include sixteen antenna elements…" from which "sixteen different communication beams 602(0), 602(1),…,602(15) are formed," each of which may have beam patterns that "differ in width, shape, number, angular coverage, azimuth, and so forth." Ex. 1001 at 9:12-

34; *see* Ex. 1001 at 6:61-7:5 ("directed communication beams 214 of antenna array 302 can be directionally controllable").

31. The '376 Patent apparatus receives signal transmissions via the directed communication beams from other devices or "nodes within the wireless routing network." Ex. 1001 at 24:25-34. Further, the '376 Patent apparatus determines a set of weighting values based on multiple received signals from each node. For example, as shown in Figure 12 below, "communication and/or data transfer signals are received from sources 1202 (e.g., sources A and B)." Ex. 1001 at 24:25-34. These signals are provided to a "signal control and coordination logic 304" which includes a "scanning receiver 822 that is configured to update routing information 1206 with regard to the received signals." Ex. 1001 at 24:35-25:30.

32. After determining a set of weighting values based on the received signals, the "stored weighting values associated with each connection, data signal, and/or source are utilized in a weighting matrix 1210 which operates to apply the latest weighting values to the received signals and also to transmitted signals." Ex. 1001 at 25:1-29.

5. CLAIM CONSTRUCTION

33. I understand that Dr. Ding did not opine on claim construction, and that Petitioner has asserted that claim construction is not necessary in this proceeding. Petition at 3.

34. I also understand that claim construction order have been entered in related district court actions construing certain terms and giving certain terms their plain and ordinary meaning.

35. In *XR Comm'ns LLC v. D-Link Sys.*, No. 8:17-cv-569-DOC-JDE, Dkt. No. 280 (C.D. Cal. Jan. 27, 2022), the Special Master in that action recommended the following constructions relevant to the claims at issue here:

Term	Special Master's Recommendation
"a processor configured to: generate a probing signal for transmission to at least a first client device and a second client device"	Plain meaning.
"wherein one or more of the processor, the transceiver, or the smart antenna is further configured to: …"	Plain meaning (As discussed above, the claims require only that "one or more" "is further configured," not necessarily that each and every one of "the processor," "the transceiver," and "the smart antenna" is so configured)
"an 802.11 standard"	"one of the IEEE 802.11 standards that existed at the time of the invention"

Ex. 2012.

36. In the same action, *XR Comm'ns LLC v. D-Link Sys.*, No. 8:17-cv-569-DOC-JDE, Dkt. No. 312 (C.D. Cal. Apr. 18, 2022), the court in that action adopted the following constructions relevant to the claims at issue here:

Term	Court's Construction
"a processor configured to: generate a probing signal for transmission to at least a first client device and a second client device"	Plain meaning.

Term	Court's Construction
"wherein one or more of the processor, the transceiver, or the smart antenna is further configured to: …"	Plain meaning (As discussed in the R&R, the claims require only that "one or more" "is further configured," not necessarily that each and every one of "the processor," "the transceiver," and "the smart antenna" is so configured, see R&R at 25.)
"an 802.11 standard"	"one of the IEEE 802.11 standards that existed at the time of the invention"

Ex. 2013.

37. In *XR Comm'ns LLC v. Cisco Sys.*, No. 6:21-cv-00623-ADA, Dkt. No. 56 (W.D. Tex. Sept. 30, 2022), the court in that action adopted the following constructions relevant to the claims at issue here:

Term	Court's Final Construction
"802.11 Standard"	Plain-and-ordinary meaning.
"transmission nulls"	Plain and ordinary meaning wherein the plain-and-ordinary meaning is "portions of one or more spatially distributed patterns of electromagnetic signals where transmissions of no or insignificant energy are selectively directed."
"transmission peaks"	Plain-and-ordinary meaning[1] [1] – Note not for the jury: The plain-and-ordinary meaning of "transmission peaks" includes relative maxima.

Ex. 2014.

38. In my opinions below, I have applied the plain and ordinary meaning of each claim term. My opinions would be the same either without claim construction or under any of the claim construction orders described above.

6. RESPONSE TO DR. DING'S OPINIONS

6.1. "*Processor*" Limitations

39. Dr. Ding asserts in paragraph 105 of his declaration that "the combination of Gerlach and Barratt discloses or suggests 'a processor' configured as described in the limitations discussed in Sections X.B.2.b(i) and X.B.2.b(ii)." Ex. 1003 ¶ 105. I disagree. In my opinion, Dr. Ding and Petitioners have failed to show that the combination of Gerlach and Barratt discloses or suggests "a processor configured to . . ." as required by claim 1 and the challenged claims.

6.1.1. Requirements of "Processor" Limitations

40. Claim 1 of the '376 patent recites, in part, the following requirements of the claimed "processor":

[1A]	a processor configured to:
[1A(i)]	generate a probing signal for transmission to at least a first client device and a second client device;
[1A(ii)]	generate a first data stream for transmission to the first client device; and
[1A(iii)]	generate a second data stream for transmission to the second client device; and

41. Claim 1 also recites the "processor," "transceiver," and "smart antenna" as separate elements. *See* claim [1C] ("wherein one or more of the processor, the transceiver, or the smart antenna is further configured to"). Based on this claim language, a POSITA would understand that the claimed "processor," "transceiver," and "smart antenna" are distinct components. This is consistent with the remaining language of claim 1. For example, claim [1B] recites "a transceiver operatively coupled to the processor and configured to . . ." In my opinion, none of the claim language of claim 1 or other challenged claims indicates that the "processor," "transceiver," and "smart antenna" can be satisfied by the same component. A POSITA would understand that they are distinct components of the overall "data-communications networking apparatus."

42. The specification and prosecution history of the '376 patent is also consistent with the claimed "processor," "transceiver," and "smart antenna" being distinct components. For example, figures and corresponding written description depict the processor and smart antenna as separate components. *See, e.g.,* Figs. 2, 3, 6, 7, 8A, 8B, 13 (and corresponding written description):

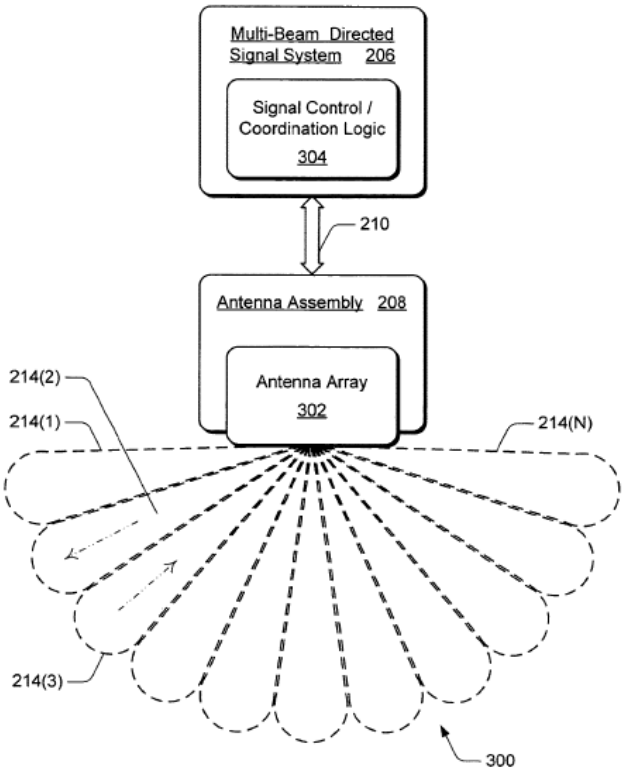
Multi-Beam Directed Signal System 206
Signal Control / Coordination Logic 304
210
Antenna Assembly 208
Antenna Array 302
214(2)
214(1)
214(N)
214(3)
300

Fig. 3

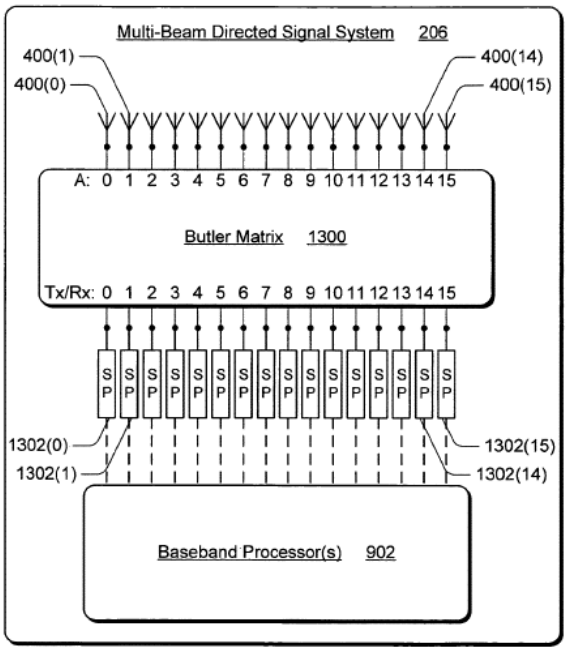
Multi-Beam Directed Signal System 206
400(1)
400(0)
400(14)
400(15)
A: 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
Butler Matrix 1300
Tx/Rx: 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
SP
1302(0)
1302(1)
1302(15)
1302(14)
Baseband Processor(s) 902

Fig. 13

6.1.2. Dr. Ding fails to show that Gerlach discloses the claimed "processor."

43. Dr. Ding asserts that "Gerlach inherently discloses or at least suggests a processor configured to perform the functionality of the limitations [of claim 1]." Ex. 1003 Ex. 1003 ¶ 109. I disagree. In my opinion, Gerlach does not disclose or suggest the claimed processor, and Dr. Ding fails to show that Gerlach alone discloses or renders the "processor" limitations obvious.

44. As an initial matter, Gerlach does not disclose the claimed processor, i.e., "a processor configured to: generate a probing signal for transmission to at least a first client device and a second client device; generate a first data stream for transmission to the first client device; and generate a second data stream for transmission to the second client device." Claim [1A]–[1A(iii)]. As Dr. Ding acknowledges, "while Gerlach describes the general concept of a wireless communications system, it has a limited description of the implementation details of a wireless network-apparatus. The specific implementation is left as a design choice to one who implements the system." Ex. 1003 ¶¶ 93–94. I agree with Dr. Ding that Gerlach only describes the "general concept" of a wireless communication system and fails to describe the "implementation details" of the system at the level required by claim 1 of the '376 patent. Therefore, Gerlach fails to disclose expressly or at all a "processor" that satisfies the requirements of claim 1.

45. For example, Dr. Ding points to signal 17(1) of Gerlach as the claimed "probing signal." Ex. 1003 Ex. 1003 ¶¶ 116–17 (annotating Gerlach Fig. 3a "to show probing signal 17(1) at left and probing signal 17(m) at right"); Pet. at 24–25 (asserting that Gerlach's wireless system "transmits the same 'probing signal' (e.g., 17(1)) to 'at least a first client device and a second client device' (e.g., 16(1)-16(m))"). Dr. Ding further points to information signals 19(1) and 19(m) as the claimed "first data stream" and "second data stream," respectively. Ex. 1003 ¶¶ 121–23; Pet. at 27 (asserting that "Gerlach discloses or suggests 'a first data stream [e.g., 19(1)] for transmission to the first client device [e.g., 16(1)]' and 'a second data stream [e.g., 19(m)] for transmission to the second client device [16(m)].'").

46. But Gerlach has no disclosure of where or how signal 17(1) or information signals 19(1) and 19(m) are generated. This is evident from Figs. 3a and 3b of Gerlach (and corresponding written description) that merely show the signals 17 and 19 in isolation and not originating from any other component (Ex. 1005, Figs. 3a, 3b annotated), and explicitly not emanating from shown weight computer 40:

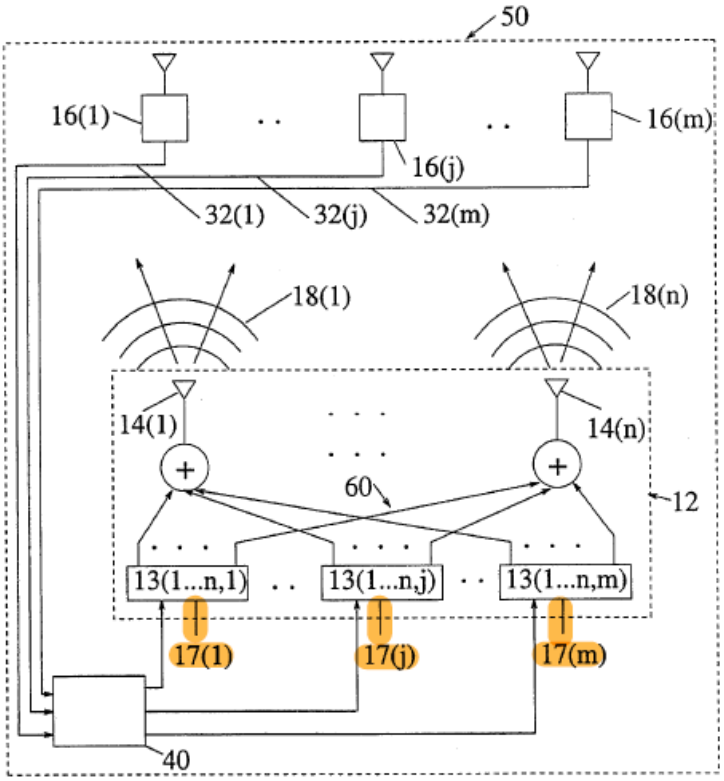
50
16(1)
16(m)
16(j)
32(1)
32(j)
32(m)
18(1)
18(n)
14(1)
14(n)
60
12
13(1...n,1)
13(1...n,j)
13(1...n,m)
17(1)
17(j)
17(m)
40

Fig. 3a

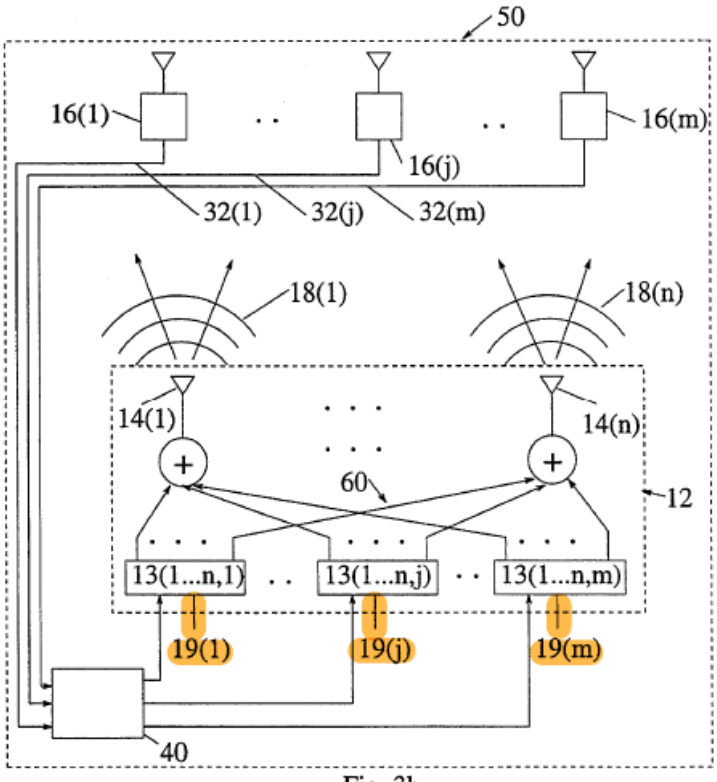
50
16(1)
16(m)
16(j)
32(1)
32(j)
32(m)
18(1)
18(n)
14(1)
14(n)
60
12
13(1...n,1)
13(1...n,j)
13(1...n,m)
19(1)
19(j)
19(m)
40

Fig. 3b

47. Accordingly, there is no disclosure in Gerlach of a "processor configured to" generate signal 17(1). A POSITA would understand that the alleged probing signals 17(1) . . . 17(m) need not be generated by a processor at all and, for example, could be hard coded into the system. Nor is there any disclosure in Gerlach of "a processor configured to" generate information signals 19(1) and 19(m). Nor is there any disclosure in Gerlach of the *same processor* that generates all of signals 17(1), 19(1), and 19(m), as required by Dr. Ding's mapping of Gerlach to the claimed processor that generates "a probing signal," "first data stream," and "second data stream."

48. Indeed, the Petition acknowledges that "Although Gerlach teaches that the transmitting array receives both probing signals 17 and information signals 19 for transmission, Gerlach does not explicitly describe the component that generates these signals." Pet. at 27. This confirms my opinion that Gerlach does not disclose or suggest the component that generates signals 17 and information signals 19. Further, it confirms my opinion that Gerlach does not disclose or suggest that the *same component* generates signals 17 and information signals 19. Those details are entirely missing from Gerlach. For these reasons, Gerlach fails to disclose claimed "processor" recited in claim 1 of the '376 patent.

49. For the same reasons I discussed above, the "processor" limitations are not inherent and Gerlach fails to inherently disclose those limitations. I understand

that inherency requires a limitation to be necessarily or always present. Based on this, "a processor configured to generate . . ." of claim 1 of the '376 patent cannot be inherent in Gerlach. At a minimum, and based on Dr. Ding's own statements, there are various architectural designs or implementations of Gerlach that would not satisfy the "processor" limitations. Ex. 1003 ¶¶ 93–94 (acknowledging that Gerlach has limited implementation details and that the "specific implementation is left as a design choice to one who implements the system."). For example, it would not be required to implement probing signals in a processor, and there is no suggestion of that in Gerlach. A probing signal could simply be generated in hardware depending on the implementation or design. As another example, different hardware components (e.g., baseband modulators) other than a processor could be used to generate Gerlach's signals 17 and information signals 19. Further, each signal 17(1)-17(m) and 19(1), and 19(m) could be generated by hardware and different hardware components.

6.1.3. Dr. Ding fails to show that Gerlach suggests or renders obvious the claimed "processor."

50. In the alternative, Dr. Ding asserts that Gerlach alone "suggests" or renders obvious the processor limitations. I disagree because Dr. Ding is using claim 1 of the '376 patent as a roadmap to speculate obviousness. Further, Dr. Ding's opinions boil down to his assertion that Gerlach "*could be*" implemented with a

processor that allegedly satisfies the requirements of claim 1, but he fails to show that a POSITA "*would be"* motivated to do so, especially in view of Gerlach's very narrow focus on the antenna array block. This is evident since Dr. Ding asserts in blanket fashion various implementations of Gerlach that would not even satisfy the "processor" limitations. Dr. Ding fails to distinguish between the different implementations he proposes, which undermines any assertion that a POSITA would be motivated to pursue a particular implementation. As a result, Dr. Ding fails to show the "why" and "how" a POSITA would be motivated to modify Gerlach to arrive at the claimed invention.

51. Dr. Ding asserts at paragraph 107 that: "A person having ordinary skill in the art would have understood that one or more processors would be used to generate "information signals 19 and probing signals 17." Ex. 1003 ¶ 107. As support, Dr. Ding cites several references that perform baseband modulation (bit-to-symbol mapping) to argue that a POSITA would understand that "a processor configured" would implement baseband modulation required to generate information signals. But there is no suggestion in Gerlach for such a need as Gerlach is narrowly focused on using feedback signals to form an antenna pattern with a single peak for the intended receiver using an antenna array.

52. In view of Gerlach's teachings, a POSITA would not understand or be motivated to implement baseband modulators in Gerlach's processor as Dr. Ding

suggests. As support for my opinion, I note that the Barratt secondary reference explicitly does *not* implement baseband modulators in the processor. This undermines Dr. Ding's assertion that a POSITA would implement baseband modulators in a processor based on Gerlach alone. Therefore, in my opinion, it would not be obvious to implement baseband modulation for forming information signal in a processor. Likewise, it would not be obvious to implement probing signals in a processor because there is no suggestion for that in Gerlach and probing signals could be simply generated in hardware. None of these modifications have any support in Gerlach, which has limited or no implemental details of the system and (according to Dr. Ding) the "specific implementation is left as a design choice to one who implements the system." Ex. 1003 ¶¶ 93–94. Dr. Ding is attempting to implement Gerlach to allegedly satisfy the claims, but impermissibly using claim 1 of the '376 patent as a roadmap for doing so.

53. To support a suggestion of a processor in Gerlach configured to implement the "processor limitations" of claim 1 of the '376 patent, Dr. Ding points to weight computer 40 in Gerlach for processing feedback signals (Ex. 1005, 3:45-47). Ex. 1003 ¶ 108. That portion of Gerlach states: "Feedback signals 32 are conveyed to weight computer 40 in array 12 for processing." Ex. 1005 at 3:45–47. But that disclosure in Gerlach is by no means a suggestion of a processor configured to generate probing signals and a first and second data streams as required by claim

1. Gerlach's weight computer 40 in array 12 extracts information from feedback signals to compute weights and achieve beam forming objectives ("Feedback signals 32 are conveyed to weight computer 40 in array 12 for processing," Ex. 1005, 3:46-48), no need for additional processor is disclosed. Narrowly focused Gerlach (on the antenna array block) does not need a processor for generating probing signals or to perform baseband modulation. Moreover, Gerlach explicitly shows in Figs. 3a and 3b that probing signals (17) and information signals (19) are not emanating from weight computer (40) that Dr. Ding suggests being "a processor configured to"

54. This further supports my opinion that Gerlach does not suggest a processor that generates probing signals 17 and information signals 19. If it did, one would expect a processor to be shown in Gerlach's figures or for signals 17 and information signals 19 to be emanating from weight computer 40. Thus, Dr. Ding's conclusory statement is not supported by his citation to Gerlach. Moreover, as I explained above, probing signals could be generated in hardware, just as baseband modulators for generating modulating signals could be advantageously implemented outside a processor, as shown in Barratt. In my opinion, Dr. Ding is using impermissible hindsight to read into Gerlach what is not disclosed suggested in the reference.

55. In paragraph 108, Dr. Ding summarizes his obviousness theory and conclusion based on Gerlach alone. He asserts: "A person having ordinary skill in

the art would have sought to use a processor—whether the same processor that implements the weight computer or one or more additional processors—to execute software instructions for generating modulating signals." Ex. 1003 ¶ 108. This theory fails for several dispositive reasons. As a result, Gerlach does not render obvious the "processor" limitations.

56. *First*, Dr. Ding's generalized assertion that a POSITA "would have sought to use a processor" in Gerlach is insufficient for meeting the "processor" limitations. Claim 1 of the '376 patent requires a processor configured to generate a probing signal for multiple client devices and to generate a first data stream for transmission to a first client device and a second data stream for transmission to a second client device. Dr. Ding's generalized motivation to use a processor in Gerlach is not specific to the claim requirements. For example, Dr. Ding does not describe any motivation for using a processor to generate probing signals (compared to other hardware or architecture designs). Nor does Dr. Ding describe any motivation for using the same processor to generate first and second data streams. Especially since Gerlach fails to disclose the claimed "processor," Dr. Ding needed to explain why and how a POSITA would implement a processor in Gerlach to arrive at the claimed invention. Dr. Ding failed to do so.

57. *Second*, Dr. Ding's primary theory that a POSITA would have sought to use "the same processor that implements the weight computer" (Ex. 1003 ¶ 108)

as the claimed "processor" is fatally flawed. Dr. Ding and Petitioners repeatedly identifies Gerlach's weight computer 40 as part of the claimed "smart antenna." *See, e.g.*:

- "Accordingly, ***weight computer 40***, components of transmitting array 12 (highlighted blue in annotated Fig. 3b above) and the antenna array *together are a "smart antenna" because these components allow the directed beampattern to be adjusted."* Ex. 1003 ¶ 139 (emphasis added);

- "As shown in Gerlach's Fig. 3b, the antenna elements, components of transmission array that adjust the generated beampattern, *and the weight computer (collectively the 'smart antenna')* are coupled to the transmitter and receiver ('transceiver')" Ex. 1003 ¶ 139 (emphasis added).

- Accordingly, weight computer 40, components of transmitting array 12 (shaded blue in Fig. 3b) and the antenna array collectively comprise "smart antenna" because these components allow the directed beampattern to be adjusted. Ding, ¶139." Pet. at 38.

58. Dr. Ding likewise asserts that weight computer 40 is part of the claimed "smart antenna" to support their mapping for the challenged dependent claims that recite "one or more of the processor, the transceiver, or the smart antenna is further configured to . . ." *See* Claims 2–6, 13–17, 23–29, 33–34.

59. Furthermore, Dr. Ding's theory that weight computer 40 could be claimed "a processor" is clearly wrong in view of Gerlach itself that states that weight computer 40 is part of antenna array (Feedback signals 32 are conveyed to weight computer 40 in array 12 for processing," Ex. 1005, 3:46-48), as also noted by Dr. Ding. Ex. 1003 ¶ 71. Moreover, Dr. Ding is mapping, in view of Gerlach, array 12 (including weight computer 40) as claimed smart antenna for the limitation "wherein one or more of the processor, the transceiver, or the smart antenna is further configured to: … transmit first data stream … transmit the second data stream …" Ex. 1003 ¶ 170-173. As I explained above, it would not be correct to use weight computer 40 for both the claimed "processor" and "smart antenna."

60. Dr. Ding repeatedly is using weight computer as part of array 12 for mapping it to "the smart antenna". See Dr. Ding's discussion for sets of claims {2, 13 23,32}, {4, 15, 26}, {5, 16, 24, 27} and {6,17,28,29}. For example, regarding Claim 2, Dr. Ding states at paragraph 210: "Accordingly, in my opinion, the combination of Gerlach and Barratt teaches the smart antenna determines a matrix W' (a first set of weights), based on which Gerlach places transmission peaks and transmission nulls in spatially distributed patterns of electromagnetic signals." *See* Ex. 1003 ¶¶ 208–10. That confirms that weight computer 40 (which calculates the weights, *see, e.g.* Ex. 1003 ¶¶ 208–09) is mapped to the claimed "smart antenna," in

view of Gerlach. Therefore, to reinstate once more, Dr. Ding is incorrect when trying to map weight computer to both "the processor" and "the smart antenna."

61. Because Gerlach's weight computer 40 is already part of the alleged "smart antenna," it cannot constitute the separate "processor" claim element. As I discussed above, both the claim language and specification of the '376 patent support the understanding that the "processor" and "smart antenna" are distinct components. A POSITA would not understand that Gerlach's weight computer 40 could both be a portion of the claimed "smart antenna" and the claimed "processor." Therefore, Dr. Ding's primary obviousness theory that a POSITA would have sought to use "the same processor that implements the weight computer" as the claimed processor would not even work. The resulting combination (itself inadequately explained) would not meet the claim language reciting "processor," "transceiver," and "smart antenna" as separate elements.

62. *Third*, Dr. Ding's overall assertion, that a POSITA "would have sought to use a processor—*whether the same processor that implements the weight computer or one or more additional processors*" demonstrates the lack of motivation to combine here. Dr. Ding merely identifies several possibilities for the hypothetical processor, primarily as the weight computer or one or more additional, unknown processors somewhere in the system. At most, this shows that different implementations are possible (with or without additional processors), and that some

undisclosed permutation is alleged to satisfy claim 1. But Dr. Ding fails to distinguish between the different implementations he proposes, including those that cannot satisfy the claims. This undermines any assertion that POSITA would be motivated to pursue a particular implementation that allegedly satisfies the "processor" limitations. Nor does Dr. Ding give any specific explanation or evidence for why a POSITA would be motivated to implement Gerlach to meet the claimed "processor," beyond the general motivation of using processors, which may or may not meet the claims.

63. *Fourth*, Dr. Ding's reference to "one or more additional processors" is entirely non-specific and unsupported. Dr. Ding fails to articulate what they are, where they are located, and what functions they perform. Such a theory fails for the same reasons above. In view of Gerlach, Dr. Ding has failed to explain any motivation for adding "one or more additional processors" to perform the claimed functions. Dr. Ding is attempting to implement Gerlach to satisfy claim 1, but impermissibly using claim 1 of the '376 patent as a roadmap for doing so.

6.1.4. Dr. Ding fails to show that Gerlach in combination with Barratt suggests or render obvious the claimed "processor."

64. For the same reasons as Gerlach alone, Gerlach in combination with Barratt fails to suggest or render obvious the claimed "processor." Dr. Ding's reliance on Barratt does not cure any of the deficiencies discussed above for the

obviousness theory for Gerlach. Indeed, the combination with Barratt includes additional deficiencies that further undermine the theory.

65. Dr. Ding suggests at paragraphs 111 that a POSITA "would have found it obvious to implement Barratt's signal modulators 25 in software on a processor, either using the same CPU as the base station controller or using one or more additional processors." Ex. 1003 ¶ 111. I disagree, this is again inadmissible hindsight, Dr. Ding is using the invention as a roadmap to obviousness. First, a POSITA would understand that the base station controller normally does not do signal modulation, just as the signal modulators in Barratt were explicitly outside of the base station controller. Second, there was not suggestion in Barratt, nor has Dr. Ding pointed to any, that signal modulators could be implemented in one or more processors. Dr. Ding theory is that signal modulators could be implemented in software running on processors. But Barratt undermines that theory because it shows the opposite. It shows dedicated the use of dedicated signal modulators, not software-based signal modulators running on the processor.

66. At paragraph 112 Dr. Ding states "a person having ordinary skill in the art would have found it obvious to incorporate Barratt's modulators/processor(s) in Gerlach to generate the probing and first/second information signals for the reasons discussed in Section X.B.1." I disagree. First, Dr. Ding in Section X.B.1 did not discuss motivation to combine Gerlach and Barratt to incorporate Barratt's signal

modulators in Gerlach to generate the probing and first/second information signals. Further, as I discussed above, Dr. Ding's obviousness logic is flawed for various reasons and, in my opinion, a POSITA would not be motivated to modify Barratt to include signal modulators in the base station controller or other processor. Nor would a POSITA be motivated to bring such modified processor in Barratt into Gerlach (which itself is unexplained). For example, Dr. Ding has never adequately articulated why a POSITA would be motivated to add a processor to Gerlach to generate probing signals (and other limitations) where Gerlach has no such suggestion. Barratt does not address that deficiency since it does not describe probing signals or Gerlach's feedback concepts.

6.2. "Transceiver" Limitations

67. Under its plain and ordinary meaning, "transceiver" refers to a single unit comprising a transmitter and a receiver, with common circuit components for transmitting and receiving. This understanding is supported by the relevant definitions for "transceiver" in the IEEE 100 Authoritative Dictionary of IEEE Standards Terms, 7th Ed. (2000), Ex. 2015 ("The combination of radio transmitting and receiving equipment in a common housing, usually for portable or mobile use, and employing common circuit components for both transmitting and receiving.") and the McGraw-Hill Dictionary of Scientific and Technical Terms, Fourth Edition (1989), Ex. 2016 ("A radio transmitter and receiver combined in one unit and having

switching arrangements such as to permit use of one or more tubes for both transmitting and receiving."). In particular, a combination of a transmitter with an unrelated receiver, *e.g.*, a receiver for a different communication technology, is not a "transceiver."

68. As Dr. Ding admits, Gerlach does not expressly disclose either a receiver or a transmitter, much less a transceiver. Ex. 1003 ¶ 125. In fact, Gerlach shows and describes the transmit and receive channels as entirely separate, teaching away from the use of a transceiver as described and claimed in the '376 Patent.

69. Dr. Ding suggests that Gerlach inherently discloses at least a transmitter because it must include a transmitter to transmit signals 18. Ex. 1003 ¶ 126. Dr. Ding identifies only a single location for the transmitter in Gerlach: as part of transmitting elements 14. *Id.* ("transmitting elements 14 in Gerlach's network-based apparatus each must include a transmitter to effectuate the transmission of signals 18 to the remote devices.").

70. Dr. Ding also argues that Gerlach must include a receiver in order to receive the feedback signals 32. Ex. 1003 ¶ 126. This is not shown. Gerlach does not specify or limit how feedback signals 32 are transferred from receivers 16 to weight computer 40. In many possible embodiments, feedback signals are transferred using some separate channel unrelated to the channel used for transmissions signals 18. For example, it is conceptually possible to use wires for the feedback signals 32,

although this would be unlikely in a practical embodiment of Gerlach. More likely, the feedback signals could be sent using a different radio link, for example at a very different frequency from the forward channel. A POSITA would understand that such an embodiment would be beneficial because, for example, it would reduce contention on the forward channel and would cleanly separate the forward and reverse channels.

71. In each of these situations, it is clear that an embodiment of Gerlach would not include a transceiver under the plain and ordinary meaning of that term. For example, the transmit and receive chains might use totally different technologies. Or, in the case of using different radio bands, the transmitter and receiver would be separated, for example by having separate front ends and other parts of the transmit and receive chains, in contrast to the plain and ordinary meaning of "transceiver."

72. Furthermore, Dr. Ding does not show that the supposed transmitter and receiver in Gerlach form a single unit or have common components. As mentioned above, Dr. Ding states that the transmitters are within transmitting elements 14, but he associates the receiver with feedback signals 32. There is no logical relationship shown between transmitting elements 14 and feedback signals 32. As shown in Gerlach, there are several components separating transmitting elements 14 and feedback signals 32, including connections 60, the weight matrix with its complex

amplitudes 13, and the entirety of weight computer 40. Ex. 1005, Figs. 3a, 3b. Dr. Ding gives no basis why these separately located transmitters and receiver would be formed in a single unit or share common components.

73. In particular, it is not inherently disclosed that the supposed transmitters and receivers form a single unit and share common components, because there are many possible embodiments that do not have those attributes. For example, if the feedback signals 32 are received using antenna element(s) distinct from the forward channel elements 14, then it would be unlikely for the transmitter(s) and receiver(s) to share components. Furthermore, if the forward and reverse channels are designed to operate simultaneously (*e.g.*, using different frequency bands), then the transmitter(s) and receiver(s) would necessarily be fully independent.

74. In addition, Dr. Ding does not show that it would be obvious to modify Gerlach to add a unitary transceiver for both the transmit elements 14 and the reception of feedback signals 32. As I describe above, there are numerous possible implementations of Gerlach, many of which would not include a transceiver as claimed. Furthermore, Dr. Ding does not address why it would be obvious, in light of Gerlach alone, to contain a transceiver in which the transmitter and receiver share components.

75. Instead, Dr. Ding relies on an obviousness combination with Barratt to show a "transceiver." Ex. 1003 ¶¶ 127-130. This is also not shown.

76. In Dr. Ding's primary theory, the disclosure of a multichannel transmitters 14 and multichannel receivers 15 constitute a "transceiver." Ex. 1003 ¶¶ 127-128. This does not show a transceiver for the same reasons I provide above regarding Gerlach. In particular, Barratt discloses that transmitters 14 are coupled to transmit antenna elements 18, and receivers 15 are coupled to receive antenna elements 19. Ex. 1006, Fig. 1; *id.* at 8:60-67 (describing separate transmit antennas 18). Transmitters 14 and receivers 15 are not even coupled to each other as disclosed in Barratt, much less are they part of a single unitary transceiver. Furthermore, Barratt expressly teaches that the uplink channel (associated with receivers 15) and downlink channel (associated with transmitters 14) may be qualitatively different. Ex. 1006 at 9:1-17:

> In the illustrative embodiment the number N_{cc} of downlink conventional channels is the same as the number N_{cc} of uplink conventional channels. In other embodiments, there may be different numbers of uplink and downlink conventional channels. Furthermore, the channels may be of different types and bandwidths as is the case for an interactive television application where the downlink is comprised of wideband video channels and the uplink employs narrowband audio/data channels.
>
> Additionally, the illustrative embodiment shows the same number of antenna elements, m, for transmit and receive. In other embodiments, the number of transmit antenna elements and the number of receive antenna elements may be different, up to and including the case where transmit employs only one transmit antenna element in an omnidirectional sense such as in an interactive television application.

77. In the cases where the uplink and downlink channels are different, a single transceiver may not be used. Therefore, even if Dr. Ding is correct that a POSITA would combine Gerlach and Barratt, Dr. Ding does not show that the combination renders obvious the use of a transceiver as taught and claimed in the '376 Patent.

78. Finally, Dr. Ding relies exclusively on five lines of Barratt to establish a transceiver in which the transmitter and receiver share components, as required by the plain and ordinary meaning of "transceiver. " Ex. 1003 ¶ 130 (quoting Ex. 1006 at 20:30-35). In his report, Dr. Ding gives only one reason why a POSITA would combine this embodiment of Barratt with Gerlach: "A person having ordinary skill in the art would have been motivated to use this embodiment having a shared antenna array and duplexer to minimize the space and cost taken by the antenna arrays at a base station which is size constrained and to minimize overall base station cost." Ex. 1003 ¶ 82.

79. In my opinion, Dr. Ding has not shown that a POSITA would be motivated to combine Gerlach with the specific alternative embodiment of Barratt that contains a shared antenna array and duplexer. In particular, Dr. Ding gives no explanation why a POSITA would consider space and cost to be important enough to justify the use of a shared antenna array and duplexer. Nothing in Gerlach teaches that cost or space are significant considerations. Although in a completely generic

sense it is usually better for a system to be cheaper or smaller, engineering is always about trade-offs. Using a shared antenna array and duplexer eliminates several attributes of both Gerlach and Barratt, and Dr. Ding does not explain why a POSITA at the time of the invention would find these compromises worthwhile.

80. Actually, Barratt's primary embodiment (see Ex. 1006, Fig.1), which Dr. Ding used for the transceiver (Ex. 1003 ¶ 127), explicitly discloses completely separate sets of transmit and receive antenna array elements. It therefore is teaching away from Dr. Ding's obviousness theory of shared antenna arrays and duplexer. For the argument that transmitters and receivers share common elements, the duplexer and antenna array, Dr. Ding is using the alternative embodiment of Fig. 8 in Barrat. Dr. Ding is mixing the two incompatible embodiments without explaining how the incompatibility could be overcome.

81. For example, as I describe above, Barratt explicitly teaches the benefits in design flexibility provided by the use of separate uplink and downlink channels, for example by having high-bandwidth downlink channels for television or video and the uplink channels can be optimized for lower bandwidth, or by using only an omnidirectional, single-antenna uplink channel instead of the more complex and power-consuming multi-antenna downlink channel. Ex. 1006 at 9:1-17. Furthermore, a POSITA would understand that using separate uplink and downlink channels, with separate transmitter(s), receiver(s), and antenna element(s), would

allow the use of distinct frequency bands, and numerous other design possibilities to tailor the wireless system for the unique demands of the uplink and downlink channels respectively. Using different frequency bands as in Barratt, sufficiently separated, *e.g.* 900 MHz and 2 GHz bands, would necessitate the use of separate antennas to achieve acceptable antenna efficiencies in each band.

82. Therefore, even if Dr. Ding were generally correct that a POSITA would be motivated to combine Gerlach and Barratt in general, he has not shown that a POSITA would use the specific alternative embodiment with a shared antenna array and a duplexer. Rather, in my opinion a POSITA considering these two references together would choose the primary embodiment of Barratt, with separate uplink and downlink channels, which more closely resembles the embodiments of Gerlach, with separate data transmission and feedback channels (corresponding to transmission signals 18 and feedback signals 32, respectively).

I declare under penalty of perjury pursuant to the laws of the United States that the foregoing is true and correct.

Executed this 13th day of January, 2023.

Branimir Vojcic, D.Sc.